

MILITARY SPECIFICATION

CONNECTORS, ELECTRIC, RECTANGULAR, HIGH DENSITY, POLARIZED CENTER JACKSCREW, GENERAL SPECIFICATION FOR

INACTIVE FOR NEW DESIGN AS OF 1 OCTOBER 1986

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers rectangular electrical connectors, with size 22 nonremovable solder type contacts, and rear removable crimp type contacts, environment resistant and nonenvironment, intended for use in electronic and electrical equipment (see 6.1).

1.2 Classification.

1.2.1 Classes:

- G - General purpose, nonmagnetic, high density, size 22, rear release crimp removable contacts.
- P - Environment resisting, potting type, nonmagnetic, high density, size 22, rear release crimp removable contacts.
- E - Environment resisting, nonmagnetic, high density, size 22, rear release crimp removable contacts.
- S - Solder termination general purpose, high density, nonremovable size 22 contacts.
- SE - Solder termination, environment resisting, high density, nonremovable size 22 contacts.

1.2.2 Part number. The part number shall consist of the letter "M", the basic number of the specification sheet, an assigned dash number and a polarization letter (see 3.1) as shown in the following:

M —	28804/1 —	-1 —	N —
Military designator	Specification sheet number	Dash number	Polarization (see figure 1).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-H-5606 - Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Space and Naval Warfare Systems Command, SPAWAR 81111, Washington DC, 20363, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-C-14550	- Copper Plating, (Electrodeposited).
MIL-I-17214	- Indicator, Permeability; Low-Mu (Go-No-Go).
MIL-T-22520/2	- Crimping Tools, Terminal, Hand, Wire Termination for Wire Barrel Sizes 20 Through 28.
MIL-W-22759	- Wire, Electric, Fluoropolymer-Insulated, Copper or Copper Alloy.
MIL-L-23699	- Lubricating Oil, Aircraft Turbine Engines, Synthetic Base.
MIL-M-24519	- Molding Plastics, Polyester Thermoplastic.
MIL-G-45204	- Gold Plating, Electrodeposited.
MIL-C-45662	- Calibration System Requirements.
MIL-P-46161	- Plastic Molding Material, Polyterephthalate Thermoplastic, Glass Fiber Reinforced.
MIL-C-55330	- Connectors, Preparation for Delivery of.
MIL-W-81381	- Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy.
* MIL-I-81969	- Installing and Removal Tools Connector Electrical Contact General Specification For.

(See supplement 1 for list of associated specifications.)

STANDARDS

MILITARY

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-202	- Test Methods for Electronic and Electrical Component Parts.
MIL-STD-454	- Standard General Requirements for Electronic Equipment.
MIL-STD-1285	- Marking of Electrical and Electronic Parts.
MIL-STD-1344	- Test Methods for Electrical Connectors.
MIL-STD-1632	- Insert Arrangements for MIL-C-28804 High Density Rectangular Electric Connectors.
MS3197	- Gage Pin for Socket Contact Engagement Test.
MS27488	- Plug, Sealing, Electric Connector.

(Copies of the specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between requirements of this specification and the specification sheet, the latter shall govern (see 6.2).

3.2 Qualification. Connector assemblies or removable crimp contacts furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time set for opening of bids (see 4.4 and 6.3).

3.3 Materials. Materials shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the connectors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty for acceptance of the finished product.

3.3.1 Dissimilar metals. When dissimilar metals are employed in intimate contact with each other, protection against electrolytic corrosion shall be provided as specified in requirement 16 of MIL-STD-454.

3.3.2 Nonmagnetic materials. All parts used in connectors shall be made from materials which are classed as nonmagnetic (see 3.5).

3.3.3 Contact materials. Contacts shall be made of suitably conductive copper based alloys. All contacts shall be suitably protected from corrosion.

3.3.3.1 Contact Plating (classes G, P, and E). Contacts shall be gold-plated in accordance with MIL-G-45204, type II, grade B or C, class 1 over a suitable underplating (underplating shall have no silver content), except that the accessory (hood) on socket contacts shall be suitably protected from corrosion.

3.3.3.2 Contact plating (classes S and SE). Contacts shall be plated in accordance with MIL-G-45204, type II, grade B or C, class 1 over copper plate in accordance with MIL-C-14550, class 4, and solder terminations shall be certified to meet solderability tests of MIL-STD-202, method 208.

3.3.4 Dielectric materials.

3.3.4.1 Insert. Insert materials shall be thermoplastic polyester in accordance with MIL-M-24519, type GBT-30F, 30 percent glass filled in accordance with MIL-P-46161, grade B, class 3.

3.3.4.2 Grommets and interfacial seals. Materials shall be high grade dielectric having hardness, electrical, and mechanical characteristics suitable for the purpose intended.

3.3.5 Polarizing and engaging hardware. Polarizing and engaging hardware shall be of high grade corrosion resistant material or a material treated to resist corrosion which allow the complete connector assembly to meet the requirements of this specification.

3.4 Design, construction and physical dimensions. Connectors shall be of the design, construction, and physical dimensions specified (see 3.1). Connectors shall be designed so that neither the pins nor the sockets will be damaged during normal mating of counterpart connectors.

3.4.1 Contact design. Contacts shall be as specified on the individual specification sheet (see 3.1).

3.4.1.1 Solder contacts. Solder contacts shall be nonremovable from the insert and shall have solder post terminals as specified (see 3.1).

* 3.4.1.2 Removable contacts. Removable contacts shall be in accordance with MIL-C-28804/9 and MIL-C-28804/10. The inserts shall be designed to provide positive individual contact retention, and individual contact release from the wire side of the connector, using an M81969/1-01 tool. The insert design shall permit individual insertion and extraction of contacts without use of a retention ring, or removal of the insert or sealing members. The individual contact retention members shall be surrounded by rigid dielectric material, configured so as to limit their flexure during contact insertion and removal as required to prevent overstressing. Insertion and extraction shall be possible with a full complement of maximum outside diameter (OD) wire (see table I). Crimp barrels shall be designed to be crimped by a tool conforming to MIL-C-22520/2. Locators shall be as specified (see 3.1). For indirect shipment, connectors may be ordered without contacts (see 6.2).

TABLE I. Wire sizes and diameters.

Wire size (AWG)	Finished wire OD (inch)	
	Minimum	Maximum
26, 24, 22	0.030	0.054

3.4.2 Insert design and construction. Inserts shall be designed with suitable sections and radii such that they will not readily chip, crack, or break in assembly or in normal service. Inserts shall be molded or bonded one-piece construction, and shall not be hollowed out for weight saving purposes. Pin entry openings on socket insert faces shall be as small as practicable. Socket inserts shall provide adequate protection against a pin contacting a socket before the mating pair of connectors has been polarized. The contact retaining system shall be free of foreign material, adhesive, or any obstruction that would prevent smooth contact insertion and positive retention.

3.4.2.1 Insert arrangement. The insert arrangement shall be as indicated in MIL-STD-1632.

3.4.2.2 Contact alignment and stability. With all contacts in place, the alignment of pin and socket contacts shall always permit engagement irrespective of buildup of allowable tolerances on hole locations, distortion of contacts due to crimping, and insert location in the shell.

3.4.3 Polarization. Polarization shall be accomplished by hex keys (see figure 1) and shall be as specified (see 3.1). Polarization shall be accomplished before engagement of pins and sockets.

3.4.4 Interchangeability. All connectors having the same part number shall be completely interchangeable with each other with respect to installation (physical) and performance (function) as specified herein. Solder and crimp contact connectors shall be intermatable (see 3.1).

3.4.5 Sealing plugs (class E only). Insulated plugs shall be provided for sealing spare contact holes. The plugs shall be in accordance with MS27488. For indirect shipment, connectors may be ordered without sealing plugs (see 6.2).

3.4.6 Interfacial seal. For classes E and P, a resilient interfacial seal shall be bonded to the pin insert; for class SE, the seal shall not be bonded.

3.5 Magnetic permeability. When measured as specified in 4.6.2, the relative permeability of connectors shall not exceed 2μ .

3.6 Maintenance aging (crimp type). After testing as specified in 4.6.3, all crimp-contact connectors shall be capable of conforming to the requirements of 3.7 and 3.8.

3.7 Contact insertion and removal force. When tested as specified in 4.6.4, the axial forces required to insert and remove removable contacts shall conform with the applicable requirements of table II.

TABLE II. Contact insertion and removal forces.

	Maximum force (pounds)	
	Class	
	G and P	E
Insertion	3	15
Removal	4	15

3.8 Mating and unmating force. When tested as specified in 4.6.5, the force for mating and unmating of counterpart connectors shall meet the requirements of table III. When connectors are mated to the torque values of table III, the maximum allowable dimension between flanges shall be .320 inch. The connectors used for this test shall have the complete complement of contacts.

TABLE III. Mating and unmating force.

Shell size	Inch-pounds maximum
8	.5
10	1.13
12	2.75
14	3.25
16	4.00
18	7.00

3.9 Contact retention. When tested as specified in 4.6.6, the axial displacement of the contacts shall not exceed 0.012 inch while under load. For classes G, E, and P, connectors shall be retained in their inserts.

3.10 Dielectric withstanding voltage. When tested as specified in 4.6.7, unmated connectors shall show no evidence of breakdown or flashover. Corona shall not be considered as breakdown.

3.11 Insulation resistance. When tested as specified in 4.6.8, the insulation resistance of mated and unmated connectors shall conform to the requirements of table IV.

TABLE IV. Insulation resistance.

Class	Moisture conditioned samples (see 4.6.12)		All other samples
	After step 6 Megohms (min)	After 24 hours of conditioning Megohms (min)	
Unmated G, S and SE	1	1,000	5,000
Mated E and P	1	100	5,000

3.12 Contact resistance. When tested as specified in 4.6.9, contact resistance for mated pairs of pin and socket contacts shall be as specified in table V.

TABLE V. Contact resistance.

Wire size	Test current	Classes G, E and P		Classes S and SE	
		After salt spray	All others	After salt spray	All others
	<u>amps</u>	<u>mV (max)</u>	<u>mV (max)</u>	<u>mV (max)</u>	<u>mV (max)</u>
26	2.0	70	60	35	25
22	5.0	70	60	35	25

3.13 Contact engagement and separation force. When tested as specified in 4.6.10, socket contacts shall conform to the forces specified in table VI.

TABLE VI. Contact engagement and separation force.

Maximum individual engagement force (oz) using maximum test pin	Maximum average engagement force (oz) using maximum diameter test pin	Minimum separation force (oz) using minimum diameter test pin
12.0	9.5	0.7

3.14 Thermal shock. When subjected to the temperature extremes of table VII in accordance with 4.6.11, there shall be no damage detrimental to the operation of the connector.

TABLE VII. Temperature extremes.

Extremes	°C
Low	+0 -55 -3
High	+3 +125 -0

3.15 Humidity. When tested as specified in 4.6.12, connectors shall meet the requirements of dielectric withstanding voltage (see 3.10) and insulation resistance (see 3.1).

3.16 Vibration. When tested as specified in 4.6.13, mated connectors shall not be damaged and there shall be no loosening of parts due to vibration. Counterpart connectors shall be retained in engagement and there shall be no interruption of electrical continuity or current flow longer than 1 microsecond.

3.17 Shock (specified pulse). When tested as specified in 4.6.14, mated connectors shall not be damaged and there shall be no loosening of parts, nor shall there be an interruption of electrical continuity or current flow longer than 1 microsecond during the exposure to mechanical shock.

3.18 Durability. When tested as specified in 4.6.15, counterpart connectors shall show no mechanical or electrical defects detrimental to the operation of the connector as specified for mating and unmating forces (see 3.8) and contact engagement and separation forces (see 3.13) after 500 cycles of mating and unmating.

3.19 Salt spray (corrosion). When tested as specified in 4.6.16, mated connectors shall show no exposure of base metal due to corrosion which will affect performance as specified for mating and unmating forces (see 3.8) and contact resistance (see 3.12).

3.20 Oversize pin exclusion. When tested as specified in 4.6.17, socket contacts shall exclude the entry of a test pin .036 inch diameter. After testing, the contacts shall meet the requirements of contact resistance (see 3.12).

3.21 Probe damage. When tested as specified in 4.6.18, socket contacts shall meet the requirements of the contact engagement and separation force (see 3.13) and shall show no evidence of visible damage.

3.22 Fluid immersion. When tested as specified in 4.6.19, unmated connectors shall meet the requirements of mating and unmating force (see 3.8).

3.23 Crimp contact deformation. When tested as specified in 4.6.20, crimped contacts shall conform to the following requirements.

3.23.1 Deformation of crimped barrel. The out-of-roundness of the crimped barrel shall not exceed the maximum diameter specified in the applicable military standard by more than 0.006 inch.

3.23.2 Axial deformation. The axial bending of the crimped contact shall not exceed 0.015 inch, which includes the maximum total indicator readings permitted the contact during its manufacture.

3.24 Contact pin strength. When tested as specified in 4.6.21, the pin strength for crimp type pin contacts shall be such that a load moment of .32 inch-pound will not produce a permanent set in excess of 0.005 inch.

3.25 Crimp tensile strength. When tested as specified in 4.6.22, the tensile strength of crimp joints for individual contacts shall conform to the requirements of table VIII.

TABLE VIII. Crimp tensile strength.

Wire size (AWG)	Tensile strength (lbs minimum)
26	5
22	12

3.26 Marking. Each connector shall be legibly and permanently marked on the shell in accordance with MIL-STD-1285. The part number to be marked on the connector shell shall be as specified (see 3.1).

3.26.1 Insert marking. The contact identification and arrangement shall be as specified (see 3.1). Letters or numerals shall be raised and clearly legible or shall appear in legible contrasting colors. Positioning and arrangement of the numerals shall be such as to avoid confusion between contacts. Markings shown in MIL-STD-1632 are for the pin insert front and socket rear. Socket face and pin rear are opposite.

3.27 Altitude immersion (qualification only) (classes P, E, and SE). When tested as specified in 4.6.23 the mated connector shall meet a minimum insulation resistance of 1,000 megohms and the requirements of dielectric withstanding voltage as specified in table XII.

3.28 Workmanship. Connectors and accessories shall meet all design dimensions and intermateability requirements of this specification. Loose contacts, poor molding fabrication, damaged or improperly assembled contacts, peeling, or chipping of plating or finish, galling of mated parts, nicks and burrs of metal parts and post molding warpage will be considered adequate basis for rejection of items of quality inferior for the purpose intended.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-C-45662.

4.1.2 Assembly plants. Assembly plants must be listed on or approved for listing on the applicable qualified products list. The qualified connector manufacturer shall certify that the assembly plant is approved for the distribution of the manufacturer's parts. The assembly plant shall use only piece parts supplied by the qualified connector manufacturer. No testing other than visual examination is required of certified piece parts obtained from the qualified connector manufacturer, except when there is cause of rejection. All assemblies produced at the assembly plant shall be subjected to examination of product to assure that the assembly process conforms with the established at the qualified manufacturing plant. Quality control requirements, including Government inspection surveillance, shall be the same as required for the qualified connector manufacturer.

4.2 Classification of inspection. The inspections specified herein shall be classified as follows:

- a. Qualification inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-1344.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample size and inspection routine.

* **4.4.1.1 Connectors.** A minimum of six completely assembled plugs and receptacles, with the insert arrangement of the largest size connector of the type (1.2.1) with the same termination (crimp or solder) for which qualification is desired, shall be subjected to the examinations and tests in the sequence shown in table IX. If both classes E and S or SE connectors are being qualified at the same time, a minimum of three completely assembled plugs and receptacles with the insert arrangement of the largest size connector of the type (1.2.1) and same termination of each class shall be inspected. The connectors shall have their full complement of contacts. The minimum number of contact cavities or contacts shown in table X shall be inspected. Additional samples may be required to provide the contact cavities or contacts as specified in table X. Half of the connectors shall be wired with the maximum size wire (size 22) and the remainder shall be wired with the minimum size wire (size 26). The samples subjected to qualification testing shall be provided with counterpart connectors for those tests requiring mating assemblies. The counterpart connectors provided for this purpose shall be new, previously qualified connectors or new connectors submitted for qualification testing. Suppliers not producing mating connectors shall submit substantiating certification data that tests were performed with qualified counterpart connectors. The samples shall be representative of the manufacturer's production. Connectors shall be wired with approximately 2 feet of wire conforming to MIL-W-22759/11-22 for maximum size wire and MIL-W-81381/7,8,9 or 10-26 for minimum size wire. Termination of wires to crimp contacts shall be accomplished using a MIL-C-22520/2 crimping tool. Classes S and SE connectors may be wired with flexible printed wiring rated at the minimum test current in table V.

4.4.1.1.1 Qualification of similar classes. Qualification of class E connectors shall also qualify classes G and P.

4.4.1.2 Contacts (crimp-removable only). A minimum quantity of contacts as listed in table X shall be inspected. Half of the contacts shall be wired with maximum size wire, and the remainder shall be wired with minimum size wire as specified in 4.4.1.1. The samples subjected to qualification testing shall be provided with connectors for those tests requiring connectors or mating connector assemblies. The connectors provided for this purpose shall be previously qualified connectors. Suppliers not producing connectors shall submit substantiating certification data that tests were performed with qualified connectors. The samples shall be produced with equipment and procedures used in production.

TABLE IXA. Qualification and retention of qualification inspection (connectors).

Inspection	Requirement paragraph	Method paragraph	Test samples					
			1	2	3	4	5	6 <u>2/</u>
Examination of product	3.1, 3.3 thru 3.4.4, 3.26 and 3.28	4.6.1	X	X	X	X	X	X
Magnetic permeability <u>1/</u>	3.5	4.6.2			X	X		
Maintenance aging (crimp type)	3.6	4.6.3	X		X			
Contact insertion and removal force	3.7	4.6.4	X		X			
Mating and unmating force <u>1/</u>	3.8	4.6.5	X		X			
Contact retention	3.9	4.6.6	X	X	X	X		
Dielectric withstanding voltage <u>1/</u>								
At sea level	3.10	4.6.7.1	X	X	X	X	X	
At altitude	3.10	4.6.7.2	X	X	X	X	X	
Insulation resistance <u>1/</u>	3.11	4.6.8	X	X	X	X	X	
Contact resistance <u>2/</u>	3.12	4.6.9	X	X	X	X	X	
Contact engagement and separation force <u>2/</u>	3.13	4.6.10	X	X	X	X	X	
Mating and unmating force <u>1/</u>	3.8	4.6.5	X	X	X	X	X	
Thermal shock	3.14	4.6.11	X	X	X	X	X	
Humidity	3.15	4.6.12	X	X	X	X	X	
Dielectric withstanding voltage <u>1/</u>	3.10	4.6.7	X	X	X	X	X	
Insulation resistance <u>1/</u>	3.11	4.6.8	X	X	X	X	X	
Vibration	3.16	4.6.13	X	X	X	X	X	
Shock (specified pulse)	3.17	4.6.14	X	X	X	X	X	
Durability	3.18	4.6.15	X	X	X	X	X	
Contact engagement and separation force	3.13	4.6.10	X	X	X	X	X	
Mating and unmating force <u>1/</u>	3.8	4.6.5	X	X	X	X	X	
* Altitude immersion <u>1/</u>	3.27	4.6.23	X	X	X	X	X	
Salt spray (corrosion)	3.19	4.6.16	X	X	X	X	X	
Contact resistance	3.12	4.6.9	X	X	X	X	X	
Mating and unmating force <u>1/</u>	3.8	4.6.5	X	X	X	X	X	
Contact retention	3.9	4.6.6	X	X	X	X		
Oversize pin exclusion <u>2/</u>	3.20	4.6.17	X	X	X	X		
Contact resistance <u>2/</u>	3.12	4.6.9	X	X	X	X		
Probe damage <u>2/</u>	3.21	4.6.18	X	X	X	X		
Contact engagement and separation force <u>2/</u>	3.13	4.6.10	X	X	X	X		
Fluid immersion <u>1/</u>	3.22	4.6.19	X	X	X	X	X	
Mating and unmating force <u>1/</u>	3.8	4.6.5	X	X	X	X	X	
Crimp contact deformation	3.23	4.6.20						X
Contact pin strength	3.24	4.6.21						X
Crimp tensile strength	3.25	4.6.22						X
Examination of product	3.1, 3.3 thru 3.4.4, 3.26 and 3.28	4.6.1	X	X	X	X	X	X

1/ Not applicable for retention of qualification.2/ When using previously qualified contacts these tests are not required.

TABLE IXB. Qualification and retention of qualification
(crimp removable contacts only)

Inspection	Requirement paragraph	Method paragraph
Inspection of product- - - - -	3.1,3.3,thru 3.3.3.2, 3.4.1.2 and 3.4.2.2	4.6.1
Maintenance aging (crimp type) - - - - -	3.6	4.6.3
Contact insertion and removal force- - - - -	3.7	4.6.4
Mating and unmating force- - - - -	3.8	4.6.5
Contact resistance - - - - -	3.12	4.6.9
Contact engagement and separation force- - - - -	3.13	4.6.10
Thermal shock- - - - -	3.14	4.6.11
Vibration- - - - -	3.16	4.6.13
Shock (specified pulse)- - - - -	3.17	4.6.14
Durability - - - - -	3.18	4.6.15
Contact engagement and separation force- - - - -	3.13	4.6.10
Mating and unmating force- - - - -	3.8	4.6.5
Oversize pin exclusion - - - - -	3.20	4.6.17
Probe damage - - - - -	3.21	4.6.18
Contact engagement and separation force- - - - -	3.13	4.6.10
Crimp contact deformation- - - - -	3.23	4.6.20
Contact pin strength - - - - -	3.24	4.6.21
Crimp tensile strength - - - - -	3.25	4.6.22
Examination of product - - - - -	3.1,3.3 thru 3.4.4, 3.26 and 3.28	4.6.1

TABLE X. Samples for qualification and retention of qualification.

Contacts (minimum)	
Qualification	Retention of qualification
Classes G, E, and P	All classes
300	100

4.4.2 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.4.3 Retention of qualification. To retain qualification, the contractor shall forward via the Government inspector at 2- or 3-year intervals (see 4.5.2.1) to the activity responsible for qualification, a summary of the results for retention of qualification tests performed during that year or 2-year period, including the number and type of any part failures. If the summary of the test results indicates nonconformance with specification requirements, requalification will be required unless proof of corrective action for each failure is provided. Failure to submit the summary will result in loss of qualification for that product.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during two consecutive reporting periods, there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit the products (a representative product of each connector) to testing in accordance with the qualification inspection requirements.

4.5 Quality conformance inspection. Quality conformance inspection shall be as specified in table XIA for connectors or table XIB for contacts, and retention of qualification specified in table IXA for connectors or table IXB for contacts.

4.5.1 Inspection lot. An inspection lot, shall consist of all connectors or removable crimp contacts, as applicable, covered by a single specification sheet, produced under essentially the same conditions, and offered for inspection at one time.

4.5.1.1 Group A inspection.

4.5.1.1.1 Group A inspection (connectors). Group A inspection of connectors shall consist of the examinations and tests specified in table XIA, in the order shown.

TABLE XIA. Group A inspection (connectors).

Inspection	Requirement paragraph	Method paragraph
Inspection of product	3.1.3.3 thru 3.3.3.1 3.4.1.2 thru 3.4.2.2	4.6.1
Dielectric withstanding voltage (at sea level)	3.10	4.6.7.1
Insulation resistance	3.11	4.6.8

4.5.1.1.2 Group A inspection (crimp-removable contacts). Group A inspection of crimp removable contacts shall consist of the examination and test specified in table XIB.

TABLE XIB. Group A inspection (contacts).

Inspection	Requirement paragraph	Method paragraph
Inspection of product	3.1.3.3 thru 3.3.3.1 3.4.1.2 thru 3.4.2.2	4.6.1
Contact engagement and separation force	3.13	4.6.10

4.5.1.1.3 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality level (AQL) shall be 1.0 percent for major defects and 4.0 percent for minor defects for sampling inspection.

4.5.1.1.4 Rejected lots. If an inspection lot is rejected, the supplier shall withdraw the lot, rework it to correct the defects, or screen out the defective units, as applicable, and reinspect. Such lots shall be kept separate from new lots, and shall be clearly identified as reinspected lots. Rejected lots shall be reinspected using tightened inspection.

4.5.1.1.5 Disposition of sample units. Sample units which have been subjected to the group A inspection may be delivered on the contract.

4.5.2 Retention of qualification (connectors). Retention of qualification inspection on connectors shall consist of the examinations and tests shown in table IX. Shipment shall not be held up pending the results of this inspection.

4.5.2.1 Sampling plan. Sample connectors consisting of two mated pairs of each of the size of the types and termination and each of the sizes of the types containing contacts for which retention of qualification is desired shall be selected every 24 months. Upon passing this inspection two consecutive times, the supplier may select sample connectors every 36 months. If production of a particular part number is not current, the retention of qualification tests must take place at the time production is resumed. The testing shall revert to the original schedule which is applied to a newly qualified product. If retention of qualification on both classes G and S is desired, one completely assembled plug and receptacle of each class shall be subjected to the examinations and tests in lieu of two of a single class.

4.5.2.2 Retention of qualification (contacts). Retention of qualification shall consist of the examinations and tests shown in table IXA. Shipment shall not be held up pending the results of this inspection.

4.5.2.3 Sampling plan. The minimum quantity of contacts listed in table X shall be inspected every 24 months. Upon passing this inspection two consecutive times, the supplier may select sample connectors every 36 months. If production of a particular part number is not current, the retention of qualification tests must take place at the time production is resumed. The testing shall revert to the original schedule which is applied to a newly qualified product.

4.5.2.4 Disposition of sample units. Sample units which have been subjected to the retention of qualification inspection shall not be delivered on the contract.

4.5.2.5 Noncompliance. If a sample fails to pass retention of qualification inspection, the manufacturer shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failures. Normal inspections shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, retention of qualification inspection shall be repeated on new samples. Group A inspection may be reinstituted; however, final acceptance shall be withheld until the retention of qualification inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the qualifying activity.

4.5.3 Packageing inspection. The sampling and inspection of the preservation-packaging, packing and container marking shall be in accordance with the requirements of MIL-C-55330.

4.6 Methods of inspection.

4.6.1 Inspection of product. Connectors and associated hardware shall be examined to verify that the design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.26, and 3.28).

4.6.1.1 Final inspection of product. Final examination of crimp contacts shall include a thorough examination to insure that identification markings are legible, the contact is free from mechanical defects, there are no cracks around the crimp area, and the contacts meet the physical requirements specified herein. Examination shall be made with a device having magnification power of approximately 3 diameters.

4.6.2 Magnetic permeability (see 3.5). Permeability shall be measured on classes G, E, and P connectors with an instrument conforming to MIL-I-17214. The connectors may be wired or unwired but shall not be carrying current.

4.6.3 Maintenance aging (crimp contact connectors only) (see 3.6). Maintenance aging shall be conducted in accordance with method 2002 of MIL-STD-1344. The following details apply:

- a. M81969/1-04 tool shall be used.
- b. Installation requirements (see 4.4.1.1).

- c. Initial requirements - All contacts shall be removed and reinserted once. Connectors shall be mated and unmated once and force values recorded as specified in 4.6.5.
- d. Following the test, contact insertion and removal (see 4.6.4) and mating and unmating force (see 4.6.5) shall be performed.

4.6.4 Contact insertion and removal force (see 3.7). Contact insertion and removal force shall be conducted in accordance with method 2012 of MIL-STD-1344. The following details apply:

- a. Wire (see 4.4.1.1).
- b. Forces - As specified in 3.7.

4.6.5 Mating and unmating force (see 3.8). Mating and unmating forces shall be measured in accordance with method 2013 of MIL-STD-1344. The following details apply:

- a. Special mounting means - Normal mounting.
- b. Wire (see 4.4.1.1).
- c. Applicable hardware - Complete connector assembly.
- d. Force or torque requirement (see 3.8).
- e. Rate of mating and unmating - Maximum of 10 seconds per operation.
- f. Mating parameters - When coupling pins lock.

4.6.6 Contact retention (see 3.9). Contact retention shall be measured in accordance with method 2007 of MIL-STD-1344. The following details apply:

- a. Number of samples (see 4.4.1.1).
- b. Removal of wires - Not applicable.
- c. Applied axial force - 10 pounds minimum.
- d. Maximum displacement - .012 inch.
- e. Axial direction - Force applied to mating end of contacts.

4.6.7 Dielectric withstanding voltage (see 3.10).

4.6.7.1 Sea level. Unmated connectors shall be tested in accordance with method 3001 of MIL-STD-1344. The applicable test voltage in table XII shall be applied between all adjacent contacts and between the center hardware and each adjacent contact. For group A inspection, voltage may be applied for a minimum of 10 seconds.

4.6.7.2 Altitude. Unmated connectors shall be tested as specified in 4.6.7.1 except after 5 minutes at a simulated altitude of 70,000 feet and while still at that altitude.

TABLE XII. Test voltage (rms 60 Hz ac volts). 1/

Altitude (feet)	Moisture conditioned (see 4.6.12) samples	All other samples
Sea level	500	1200
70,000	---	375

1/ These are not working voltages.

4.6.8 Insulation resistance (see 3.11). Connectors shall be tested in accordance with method 3003 of MIL-STD-1344. Resistance shall be measured between 50 percent, but not less than four pairs of adjacent contacts and between 50 percent, but not less than four pairs of adjacent contacts and the center hardware. The contacts selected shall be those having the closest spacing between measuring points.

4.6.9 Contact resistance (see 3.12). Contact resistance shall be measured in accordance with method 3004 of MIL-STD-1344 on each mated pair of contacts.

4.6.10 Contact engagement and separation force (see 3.13). Sockets shall be mounted in a suitable position or fixture for applying gradually increasing loads for the engagement and separation of test pins from the sockets. Maximum and minimum test pins shall be in accordance with MS3197. Insertion of test pins shall be to a depth of .140 inch minimum when measured from the front of the socket contact. The test pin shall not bottom in the socket. This test shall be performed in the following sequence:

- a. Insert and separate a maximum diameter pin in and from each socket contact, then insert and remove a minimum diameter pin in the same sockets. During separation of the minimum diameter test pin, the minimum separation force shall conform to 3.13.
- b. Insert and separate a maximum diameter pin in and from each socket contact three times. During the third cycle, the engagement shall conform to 3.13.

4.6.11 Thermal shock (see 3.14). Unmated connectors shall be tested in accordance with method 1003 of MIL-STD-1344. Test condition letter shall be A1 except the minimum temperature shall be -55°C , $+0^{\circ}\text{C}$ -3°C . Following the last cycle, the connectors shall be returned to room temperature for inspection and further testing.

4.6.12 Humidity (see 3.15). Fully wired connectors shall be subjected to a humidity test in accordance with method 1002 of MIL-STD-1344, type II, and the following exceptions and details:

- a. Omit step 7.
- b. Upon completion of step 6 of the final cycle, connectors shall be removed from the chamber and surface moisture removed from the insulators.
- c. Immediately following removal of surface moisture, dielectric withstanding voltage (see 4.6.7.1), and insulation resistance (see 4.6.8) shall be measured.
- d. After the 24-hour conditioning period, the insulation resistance (see 4.6.8) shall be measured again.

4.6.13 Vibration (see 3.16). Mated connectors shall be tested in accordance with method 2005 of MIL-STD-1344, test condition IV. All contacts shall be wired in series. For size 2 wire, a strain relief clamp may be mounted directly on the connector.

4.6.14 Shock (specified pulse) (see 3.17). Mated connectors shall be subjected to method 2004 of MIL-STD-1344, test condition G. One shock shall be applied in each direction of the three major axes of the connectors. Receptacles shall be mounted similar to the mounting of 4.6.13. Plugs shall be engaged with the receptacles and shall not be held by any locking means. All contacts shall be wired in series with a minimum of 100 milliamperes of current allowed to flow and the wire bundles or cables shall be clamped to structures that move with the connectors. A minimum of 8 inches of wire or cable shall be unsupported behind the rear of the receptacle and $4 \pm 1/2$ inches of wire or cable shall be unsupported behind the rear of the plug. A suitable instrument shall be used to indicate any discontinuity or interruption of current flow.

4.6.15 Durability (see 3.18). Counterpart connectors shall be mated and unmated 500 times at a rate of 200 ± 100 cycles per hour in a manner to simulate actual service. After 500 cycles, the mated connectors shall be subjected to salt spray (see 4.6.16).

4.6.16 Salt spray (corrosion (see 3.19)). Mated connectors shall be subjected to salt spray in accordance with method 1001 of MIL-STD-1344. The following details and exceptions shall apply:

- a. Test condition B.
- b. Measurements after test: Contact resistance (see 4.6.9), and mating and unmating force (see 4.6.5) shall be measured.

4.6.17 Oversize pin exclusion (see 3.20). A hardened steel oversize pin, as specified in 3.20, shall be placed in a position centered and parallel to the axis of the socket contact. A 12 ounce axial force shall then be applied tending to force the test pin into the socket contact. After completion of the test, contact resistance (see 4.6.9) shall be measured on 20 percent or a minimum of four socket contacts in each connector.

4.6.18 Probe damage (see 3.21). Socket contacts shall be tested in accordance with method 2006 of MIL-STD-1344. The following details shall apply:

- a. Number and size of samples - 20 percent of the contacts or a minimum of four contacts.
- b. Probe damage tool shall be inserted into the contact to a depth of $.160 \pm .020$.
- c. The diameter of the handle (.190) is not applicable.
- d. The tolerance on the inch-pounds shall be ± 10 percent in lieu of the values specified in MIL-STD-1344.
- e. After testing, contact engagement and separation force (see 3.13) shall be measured.

4.6.19 Fluid immersion (see 3.22). Unmated connectors shall be immersed fully in the fluids specified below for the required periods. At least one connector shall be immersed in each fluid. After removal from the fluid, each connector shall remain for 1 hour in free air at room conditions. Subsequent testing shall be performed on connectors mated with the same mating connectors used previously in the test. The connectors shall be mated by hand. Following mating, connectors shall be cleaned in a suitable solvent to remove the hydraulic fluid and lubrication oil.

- a. Hydraulic fluid conforming to MIL-H-5606 for 20 hours.
- b. Lubricating oil conforming to MIL-L-23699 for 20 hours.

4.6.20 Crimp contact deformation (see 3.23). Contacts shall be tested in accordance with method 2001 of MIL-STD-1344. The test shall be performed on at least 40 contact pairs, selected so that 20 pairs having the maximum wire size and 20 pairs having the minimum wire size are tested.

4.6.21 Contact pin strength (see 3.24). Unless otherwise specified (see 3.1), removable contacts shall be mounted in a suitable fixture and a load applied to the pin as shown in figure 2. The rate of travel of the testing machine shall not exceed 1 inch per minute, and the load shall be maintained for 1 minute. The permanent set shall be the difference between the initial and final position of the point of load application after load removal. The test shall be performed on at least 40 contacts.

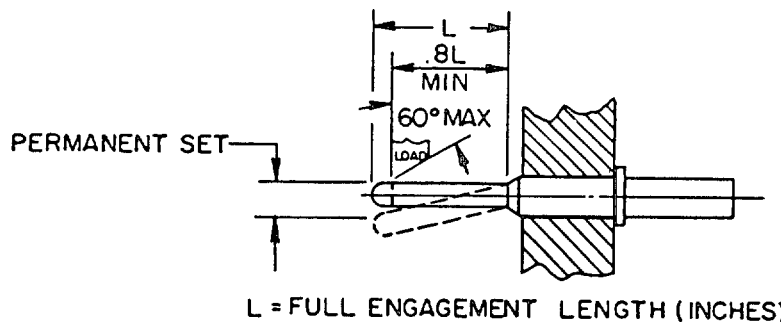


FIGURE 2. Contact strength test.

4.6.22 Crimp tensile strength (see 3.25). Crimp contacts shall be tested in accordance with method 2003 of MIL-STD-1344. Contacts shall be crimped using a tool specified in MIL-C-22520/2. The test shall be performed on at least 40 contact pairs. These shall be selected so that 20 pairs have the maximum wire size and 20 pairs have the minimum wire size.

4.6.23 Altitude immersion (classes P, E and SE) (see 3.27). Mated connectors shall be tested in accordance with method 1004 of MIL-STD-1344. The following details shall apply:

- a. All wire ends shall be located within the chamber and exposed to the chamber atmosphere but not submerged or sealed.
- b. At the end of the third cycle while the connectors are still submerged in the solution, the insulation resistance shall be measured as specified in 4.6.8 and the dielectric withstanding voltage test shall be performed as specified in 4.6.7.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-C-55330.

6. NOTES

6.1 Intended use. Connectors and contacts covered by this specification are intended for use in airborne, ground support, and shipboard electrical and electronic equipment where in presence of residual magnetism must be held to very low levels to avoid interference with nearby sensitive instrumentation.

- a. Class G connectors are intended for use in nonenvironment resisting applications where the operating temperature range of -55°C to $+125^{\circ}\text{C}$ is experienced. Crimp contact connectors have the additional advantage of possessing rear removable crimp type contacts.
- b. Class P connectors are intended for environmental resisting applications where sealing around wires is accomplished by potting.
- c. Class E connectors are intended for environmental resisting applications. Provisions are made for sealing around wire at rear of connectors. Crimp contact connectors have the advantage of possessing rear release crimp type contacts.
- d. Class S connectors are supplied with nonremovable solder post terminations. This connector is intended for use with flexible printed circuits conforming to the pin pattern and thread inserts are provided for securing printed circuit to rear of connector.
- e. Class SE connectors are supplied with nonremovable solder post terminations and interfacial seal. They are for use with the same circuitry as the class S connectors.
- f. All classes of connectors are for use in applications wherein presence of residual magnetism must be held to very low levels to avoid interference with nearby sensitive instrumentation.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Title, number, and date of the applicable specification sheet and the complete part number (see 3.1 and 1.2).
- c. (For indirect shipment only.) Whether contacts and sealing plugs are included.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable qualified products list (QPL) whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts for the products covered by this specification. The activity responsible for the qualified products list is the Naval Electronic Systems Command, Code 5043, Department of the Navy, Washington, D.C. 20360; however, information pertaining to qualification or products may be obtained from the Defense Electronics Supply Center (DESC-E), Dayton, Ohio 45444. Application for qualification tests shall be made in accordance with provisions governing qualification SD-6 (see 6.3.1).

6.3.1 Copies of specifications and "Provisions Governing Qualification" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

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6.6 Subject term (key word) listing.

Center jackscrew
Connector
Electrical
High density
Rectangular

6.7 Changes from previous issue. The margins of the specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 85

Review activities:
Army - AT, MI
Navy - AS
Air Force - 85, 99
DLA - ES

User activities:
Army - AM, AR, ME
Navy - MC

Preparing activity:
Navy - EC

Agent:
DLA - ES

(Project 5935-3546)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER
MIL-C-28804B

2. DOCUMENT TITLE
Connectors, Electric, Rectangular, High Density, Polarized...

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

☐

VENDOR

☐

USER

☐

MANUFACTURER

☐

OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)